

THE PRINCIPLES OF MANURING

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To commence I wish to make it clear that this introduction deals only with principles. I used the word introduction deliberately because the object is to initiate a discussion which I hope will result in some agreement on how manuring should be carried out in practice. I shall be provocative, and I know you all have your own ideas on the subject. We have allowed forty minutes for a discussion which I hope will be lively and spirited.

There is a common fallacy that the growth of the tea bush may be stimulated by so-called artificial manures, very much along the lines of giving an old hen some laying spice. These misleading and indeed rather dangerous ideas are sometimes carried further, alleging that nitrogenous manures stimulate vegetative growth, that potash makes wood, and that phosphates stimulate root growth. The actual stimulants to growth are light, warmth and plant hormones or growth promoting substances, over which we have no control in estate practice. Mr. Webster's paper this afternoon will give you an insight into some possible complexities of growth promoting substances.

An impression of stimulation may be given by correcting some *limiting factor*, and to claim to have stimulated the growth of tea bushes is only to admit an error of management up to the time the apparent stimulation is observed. There are many well tried methods of limiting the growth of the tea bush, the commonest being to leave insufficient maintenance foliage or, in other words to over-pluck. Other well known methods are hacking, chopping or sawing of frames by the use of various cutting instruments, smashing of frames, for which purpose over-grown shade trees may be used, the destruction of roots by over-cultivation and so on.

The limiting factor with which I am concerned in this talk is the supply of nitrogen, phosphate and potash. If these elements are not available when other conditions are favourable the potentially possible amount of growth cannot be sustained.

Assuming that we have a healthy bush with a substantial frame, there will be periods when light and warmth stimulate the leaves to absorb carbon dioxide from the air. Incidentally, I make no apology whatsoever for telling you all about carbon dioxide once more. Carbon dioxide and water constitute 90% of the crop and no amount of manure can substitute them. Adequate maintenance foliage is absolutely essential. As soon as the leaves commence to absorb carbon dioxide, growth commences and is sustained, so long as the supply of water and minerals is sufficient. Light and warmth cannot sustain growth without water and minerals and even when light, warmth and water are all adequate, growth will be limited when nitrogen, phosphate and potash are not available in adequate amounts, and in the correct proportions to take their appointed place in the complex structure of the plant. The most highly organised and generally well supplied building work must stop if any essential component, however small, is missing. In the case of plants it may be only traces of an essential element, but that is another story; we are concerned with nitrogen, phosphates and potash.

The principle of manuring is, therefore, to ensure that adequate amounts of these nutrients are ready when called for. I do not propose to confuse this principle by going into complicated details about availability, base exchange complexes, fixation

and so on. Instead, I urge you to give the utmost attention to the supplying of humus forming, NOT necessarily nitrogenous, materials and to the protection of soil from over-heating because these measures will ensure an ample supply of readily available nutrients at all times, and may be likened to a sound bank balance, both on current and on deposit account. Nevertheless, I remind you that plants can be grown on sand if a continuous supply of all essential nutrients in a balanced solution is maintained, and that even sand with incorporated humus can gradually be built up into a reasonable soil. I repeat, therefore, that the principle of manuring is to ensure that adequate amounts of nitrogen, phosphate and potash are ready when required.

Just how long it takes sulphate of ammonia, ground rock and phosphate and potash to become available to the tea bush after application to the soil, I cannot tell you ; it probably varies enormously with soil and weather conditions and a host of other factors. Anyway, it is beside the point because the principle should be to maintain a constant supply of these nutrients. It is impossible to forecast the demand and the nutrients must be literally "on tap." Even with the poorest tea soil there will be some capacity for holding nutrients and soil improvement is mainly a question of improving this capacity. The art of manuring is to keep this reserve full, and skill and judgment must always be a part of agricultural practices. No amount of scientific research or advice can completely eliminate an element of skill and experience in agriculture.

Precise field experiments of the type laid down by Dr. Eden, 25 years ago, exact chemical analyses, and skilled observation can, however, eliminate much guesswork and I am not aware of any evidence which supports the use of a routine mixture varying from T.R.I. 500 for use on tea in bearing.

T.R.I. 500

Ammonium sulphate	—	320 lb.
Saphos phosphate	—	105 lb.
Muriate of potash 50%	—	75 lb.
(or Muriate of potash 60%)	—	63 lb.)

There is no special magic in this mixture but it is the most fully informed guess that can be made for Ceylon conditions at the present time. Some time in the future we may find cause to modify or supplement this mixture but at present it appears to meet the needs of the tea bush wherever it is grown on Ceylon soils.

I suggest that there are great advantages in the use of a standard mixture because fertiliser firms can supply it at short notice, and it should not normally be necessary to store it on the estate for a length of time sufficient to require the incorporation of a conditioner. When a conditioner to prevent caking is considered desirable, the advice of the supplier should be sought in connection with the type an amount of conditioner to be used. It will increase the cost of the mixture. At the present time it is cheaper to use the 60% muriate of potash.

A few moments ago I described T.R.I. 500 as a *routine* mixture. Where there has been a long history of potash starvation, we sometimes recommend one application with additional potash but this is for the active treatment of a deficiency. Such deficiencies will not arise if T.R.I. 500 is used as a *routine* in adequate quantities. The next point therefore is how much T.R.I. 500 should be used to maintain soil reserves, and to ensure that there is always sufficient nitrogen, phosphate and potash to supply the demands of the bushes during periods of active growth. The principle is to pay into the nutrient banking account at six or nine monthly intervals lump sums sufficient to cover withdrawals.

Do not apply manure in the hope of getting it back converted into leaf — in the same spirit as you would put a coin in a cigarette or chocolate machine expecting to obtain delivery of your purchase when you pull a handle. Pay manure into the soil

to compensate withdrawals and to keep your bank account in a sound condition. Every field must have a separate account. To manure a whole estate at one level is to waste manure in low yielding areas and to starve other potentially more productive areas.

For many years we have been somewhat reluctant to publish any form of manuring guide because in general terms we can only recommend *minimum* quantities. We cannot any longer cope with the amount of work involved in advice to individual estates and in any case, judging from the figures I gave you earlier¹ in connection with sale of fertilisers during 1952 it is evident that a greatly predominant proportion of estates must be manuring on a basis closely approaching our advice. I do, however, stress that the table we will now publish should not be used mechanically. Fields which are showing a rapid increase in yield must be manured above the level suggested in the table. Heavy stands of shade trees and green manures may deserve some consideration. Especially I mention very wet districts where responses to mineral fertilisers may be much lower than the average. Again, I mention skill and experience as indispensable adjuncts to tea planting. If your experience is that 82 lb. of nitrogen is not enough to sustain an yield of 1,000 lb. per annum, then interpret our table accordingly. I am particularly anxious that agents and controlling interests in offices remote from producing areas should not interpret this table too literally. The opinion of an experienced planter is an indispensable part of management and advice from research organizations must never be allowed to usurp the place of practical experience. Plants and soil cannot be managed according to any exact system of organization or accounting.

Subject to the limitations I have discussed, the relation between yields and the quantities of manure required to sustain yields may be tabulated as follows :—

Crop lb.	T.R.I. 500 lbs. of mixture required (-2% if 60% muriate is used)	Application per annum		
		Nitrogen	Phos. Acid	Potash
400	275	36.0	17.0	21.0
450	300	40.0	19.0	23.0
500	325	43.0	20.0	24.0
550	350	46.0	22.0	26.0
600	400	53.0	25.0	30.0
650	425	56.0	26.0	32.0
700	450	59.0	28.0	34.0
750	475	63.0	29.0	36.0
800	500	66.0	31.0	38.0
850	525	69.0	33.0	39.0
900	550	73.0	34.0	41.0
950	600	79.0	37.0	45.0
1000	625	82.0	39.0	47.0
1050	650	88.0	40.0	49.0
1100	675	89.0	42.0	51.0
1150	700	92.0	43.0	53.0
1200	725	96.0	45.0	54.0

Since many planters are accustomed to thinking in terms of pounds of nitrogen per acre, the actual analysis for each quantity of manure is given but I draw your attention to the fact that in every day practice, using a standard mixture, it is redundant to give the analysis for each and every field. The habit of thinking in terms of pounds of nutrient is a good one but simplicity in practice and in routine records is

¹ The Work of the Institute — Director, p. 8 of this issue.

even more desirable. I do, however, suggest that wherever pounds of mixture are referred to in permanent records, the composition of the mixture should invariably be given, otherwise it will be extremely difficult in the future to elicit reliable information from those records. T.R.I. 500 may be entirely forgotten in 5 or 10 years' time. I mention the subject because elaborate calculations in manuring programmes are entirely unnecessary if a standard mixture is used. You will note that small adjustments are necessary if 60% muriate is used in the mixture. This really only applies in ordering bulk supplies. For the smaller quantities used in the field the correction is negligible as small differences have no practical meaning.

There seems to be considerable differences of opinion about the practicability of manuring each field, exactly according to its yield since the previous application. Compromise of some description will be necessary as the distribution of manure cannot be controlled to very fine limits. However, yield records can be referred to the table I have given and the exact theoretical amount ascertained without difficulty. The amount actually applied may be adjusted for the sake of convenience in application, and any difference added to or subtracted from the next application. The total application for the cycle should however be fully adequate.

Some estates prefer to classify fields according to yield categories and to apply manure on a routine worked out for each category. The evenness of distribution is certainly of the greatest importance and it is little use fussing about the quantity of manure to be applied, if the quantity decided upon cannot be reasonably evenly distributed over the whole field.

Distribution is a question of great importance and I hope you will express your views on this aspect in particular.

Finally, a few words about when and how frequently to apply manure. It is obviously impractical, apart from being undesirable to apply manure in very wet weather or in very dry weather. Manuring is like ploughing, harrowing and other operations involving soil, a matter of opportunity and judgment. The availability of labour is also involved and the matter must be decided by the man on the spot. If manuring is carried out according to the crop harvested in the period between two applications, the table I have given makes it simple immediately to decide how much mixture to apply at any time the weather is favourable and the labour available. There must, however, be some guiding principles and the first application in a pruning cycle should be given as soon as there is a good cover of foliage. With the light pruning now generally practised, this is usually about three months from pruning.

Whilst admitting that our experimental evidence is meagre and that opinion on the point is largely arbitrary, we advise against periods of longer than nine months between two successive applications of manure. This implies that the last application in a cycle should be not more than six months before pruning if the first application in the following cycle is to be given three months after pruning. Nine monthly intervals appear to be satisfactory for fields yielding up to about 800 lb. per acre but for yields above this figure we prefer applications at intervals of six months. All manurial programmes involve some compromise but the principles I have described are simple and are fairly easily adapted to meet varying conditions.

Perhaps some controlling interests and visiting agents maybe a little disturbed by the apparent elasticity of the system resulting from the application of the principles I have laid down. I point out, however, that it avoids wastage of manure, that it avoids starving vigorous fields and that although the total expenditure on manure cannot be exactly estimated at the beginning of any financial year, it is low in poor years, high in good years and that the cost of manure per pound of tea harvested is constant so long as the price of manure is steady. When the total expenditure on manure is decided at the beginning of a financial year the cost per pound for manuring varies with the crop harvested and is high in poor years and low in good years. This does not seem to be sound finance.